

LESSON 7

TOPIC 2

Spread Footing Design - Settlement

SPREAD FOOTING DESIGN

Lesson 7 - Topic 2 Settlement

Slide 7-2-1

SPREAD FOOTING DESIGN Settlement

- 1. Perform Settlement Analysis in Cohesive and Granular Soil***
- 2. Name Solutions to Reduce Settlement Amount or Time***

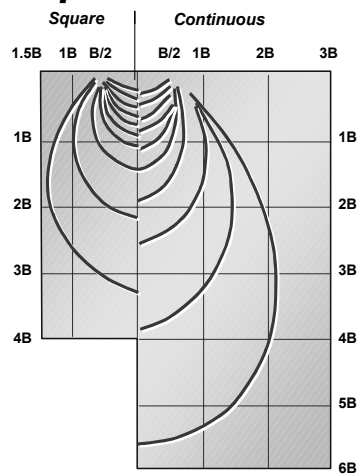
ACTIVITY: Settlement Analysis

Slide 7-2-2



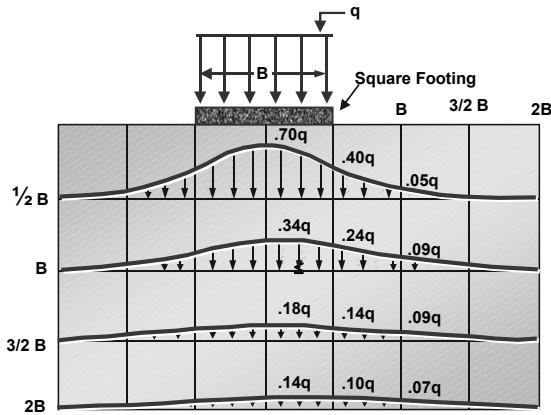
Slide 7-2-3

Boussinesq Pressure Isobars



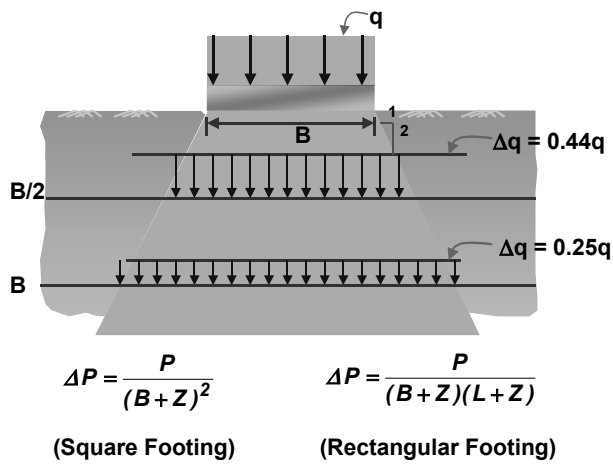
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Boussinesq Pressure Distribution



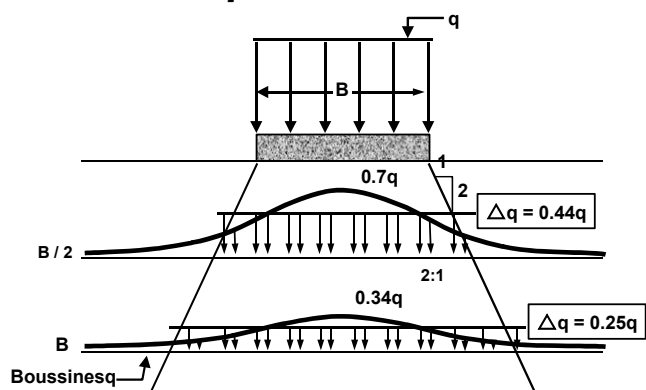
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2:1 Pressure Distribution



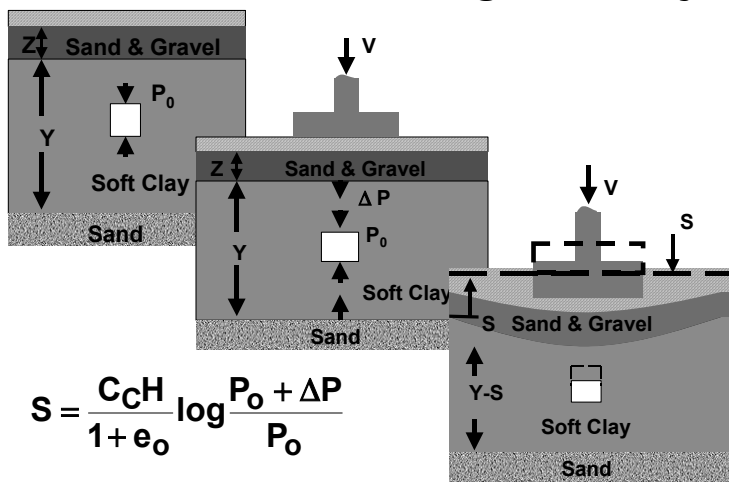
Slide 7-2-6

Comparison of 2:1 and Boussinesq Distribution



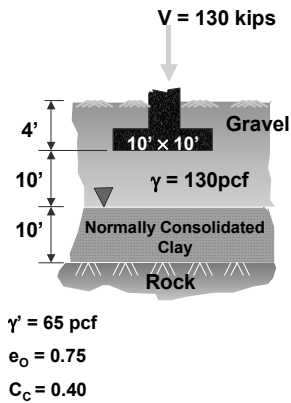
Slide 7-2-7

Settlement of Footings on Clay



Slide 7-2-8

Example: Determine the Settlement of the Footing



- Overburden Pressure at Mid-Height of Clay Deposit:

$$P_o = (14' \times 130 \text{ pcf}) + (5' \times 65 \text{ pcf})$$

$$P_o = 2145 \text{ psf}$$

- Change in Pressure at Mid-Height of Clay Deposit, using 2:1 Method

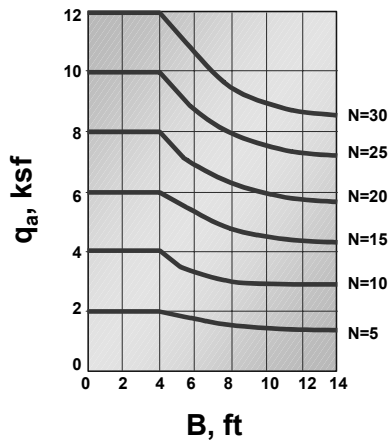
$$\Delta P = \frac{V}{(10 + 15)^2} = \frac{130,000\#}{625 \text{ ft}^2} = 208 \text{ psf}$$

$$\text{Settlement : } S = \frac{C_c H}{1 + e_o} \log \frac{P_o + \Delta P}{P_o}$$

$$S = \frac{(0.40)(10')}{1 + 0.75} \log \frac{2145 + 208}{2145} = 0.09' = 1.1 \text{ ins}$$

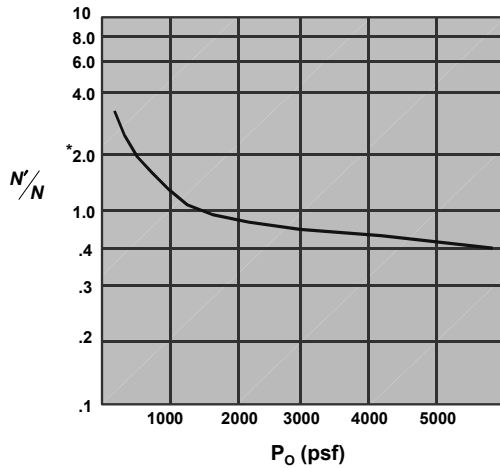
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Settlement of Granular Soil



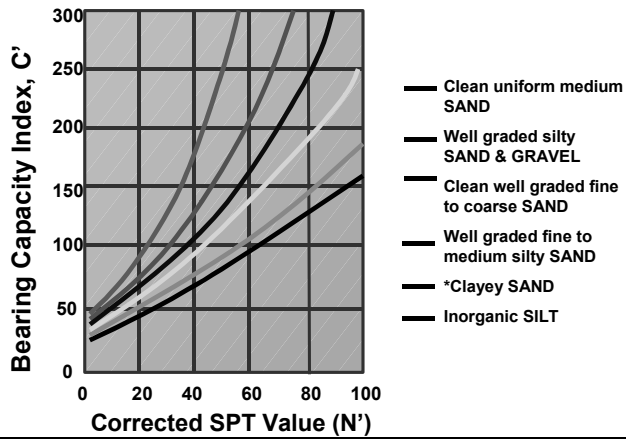
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Correction SPT (N) Blow Counts



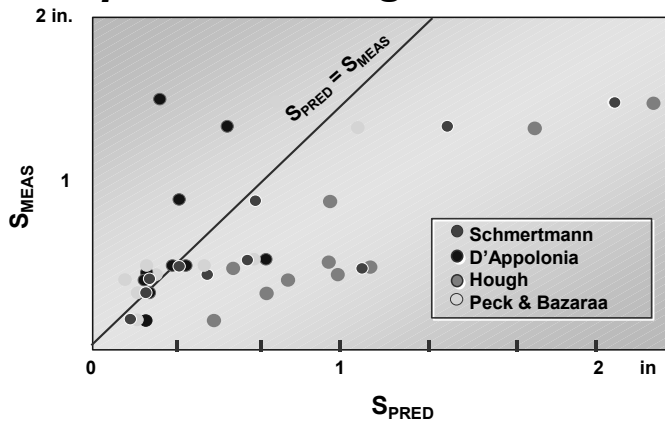
Slide 7-2-11

Bearing Capacity Index (C') Values for Granular Soils



Slide 7-2-12

Case Histories of Settlement of Spread Footings

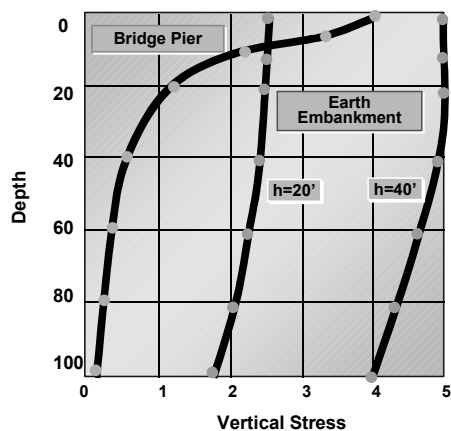


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Slide 7-2-14

Vertical Stress Distribution



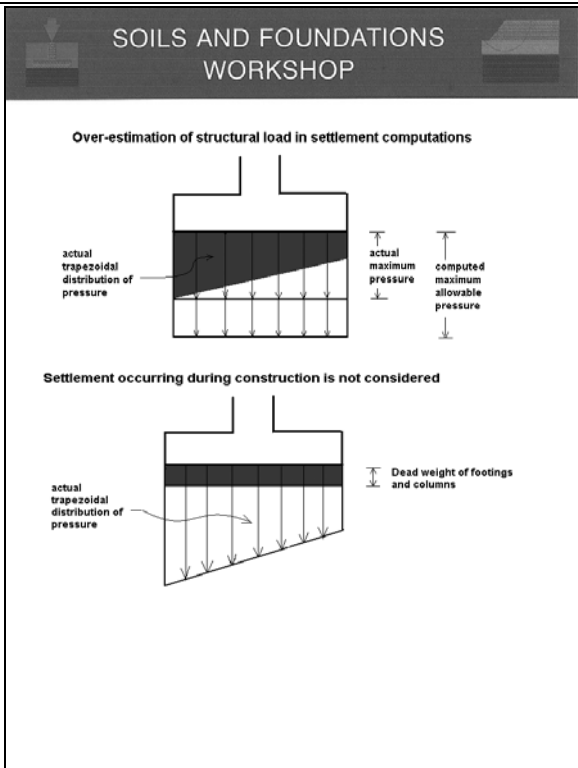
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Slide 7-2-17



Slide 7-2-18

SOILS AND FOUNDATIONS WORKSHOP

STUDENT EXERCISE NO. 6

Footing Settlement

Given: Soil Profile and Pressure Diagram Below

Find Footing Settlement Using Increments of 10'

Sand and Gravel
Avg. $N' = 40$

Clayey Silt
 $C_c = 0.25$
 $e_o = 0.90$
(Normally Consolidated)

Pressure - psf

Depth - ft.

Sand + Gravel

Clayey Silt

Slide 7-2-19

SOILS AND FOUNDATIONS WORKSHOP

Site Exploration

Basic Soil Properties

Laboratory Testing

Slope Stability

Embankment Settlement

Spread Footing Design

Pile Design

Design Soil Profile

Pier Bearing Capacity

Pier Settlement

Abutment Settlement

Vertical Drains

Surcharge

Slide 7-2-20

SOILS AND FOUNDATIONS
WORKSHOP

APPLE FREEWAY

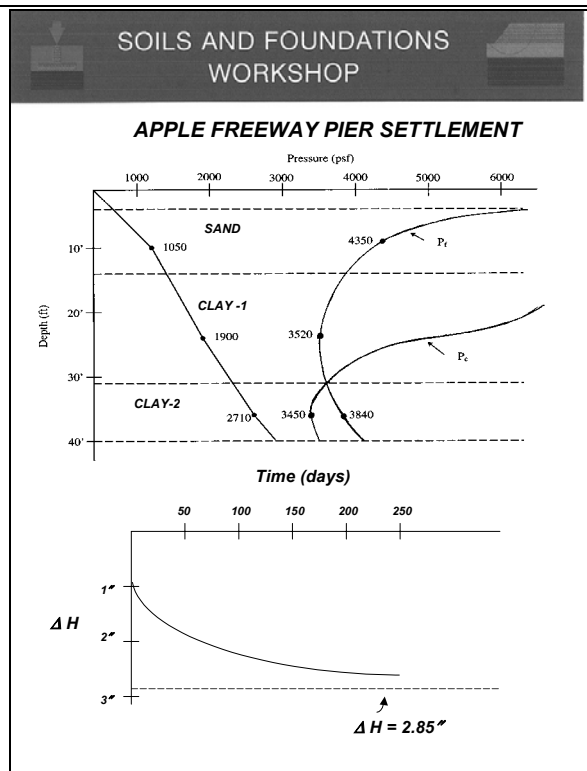
PIER BEARING CAPACITY

Assumptions:

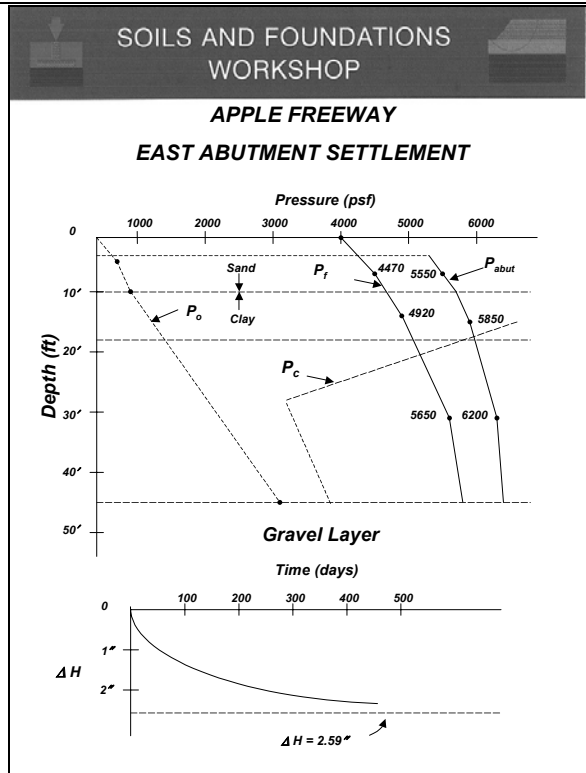
- Footing embeded 4' below ground
- Footing width = 1/3 pier height = 7'
- Footing length = 100'

$L/W = 100/7 > 9 \therefore \text{Continuous}$

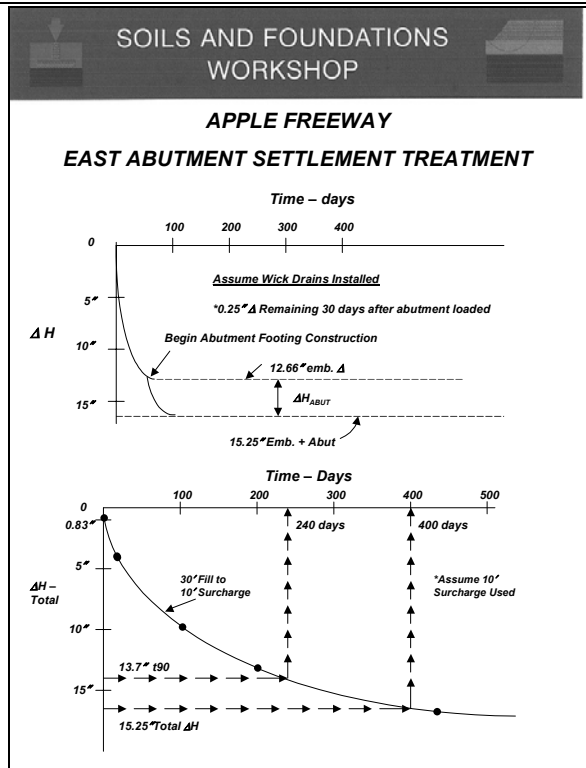
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Slide 7-2-23



Slide 7-2-24

SOILS AND FOUNDATIONS WORKSHOP

SPREAD FOOTING DESIGN

Design Soil Profile

*Strength and consolidation values selected for all soil layers.
Footing elevation and width chosen.*

Pier Bearing Capacity

$Q_{\text{allowable}} = 3 \text{ tons/sq.ft.}$

Pier Settlement

Settlement = 2.8", $t_{90} = 220 \text{ days}$.

Abutment Settlement

Settlement - 2.6", $t_{90} = 433 \text{ days}$.

Vertical Drains

$t_{90} = 60 \text{ days}$ - could reduce settlement to 0.25" after abutment constructed and loaded.

Surcharge

*10' surcharge: $t_{90} = 240 \text{ days}$
before abutment constructed.*

SPREAD FOOTING DESIGN

Design Soil Profile

**Strength and consolidation values selected for all soil layers.
Footing elevation and width chosen.**

Pier Bearing Capacity

$$Q_{allowable} = 3 \text{ tons/sq.ft.}$$

Pier Settlement

Settlement = 2.8", t_{90} = 220 days.

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Settlement - 2.6", t_{90} = 433 days.

Vertical Drains

t_{90} = 60 days - could reduce settlement to 0.25" after abutment constructed and loaded.

Surcharge

**10' surcharge: $t_{90} = 240$ days
before abutment constructed.**

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SOILS AND FOUNDATIONS WORKSHOP

Spread Footing Design Settlement

- ***Perform settlement analyses in both cohesive and granular soils***
- ***Name solutions to reduce settlement***

Activities: Settlement analysis

Spread Footing Design Settlement

- ***Perform settlement analyses in both cohesive and granular soils***
- ***Name solutions to reduce settlement***

Activities: Settlement analysis

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SOILS AND FOUNDATIONS WORKSHOP

STUDENT EXERCISE NO. 6

Footing Settlement

Given: Soil Profile and Pressure Diagram Below

Find Footing Settlement Using Increments of 10'

